PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-125126

(43)Date of publication of application : 11.05.1999

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(51)Int.Cl.

F02D 13/02
F02D 21/08
F02D 43/00
F02M 25/07
F02P 5/152
F02P 5/153

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(21)Application number : 09-289716

(22)Date of filing : 22.10.1997

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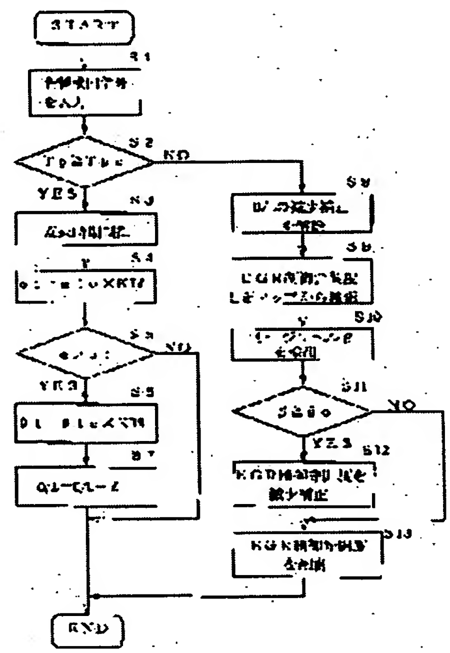
(54) EGR CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To quickly avoid a surge by adjusting internal exhaust gas reflux(EGR).

SOLUTION: In a high load region with a basic fuel injection amount Tp is being in a prescribed value Tpo or more, ignition timing control in accordance with a knocking level is performed (S1 to S3), a delay angle correction amount αat the time of this ignition timing control is compared with a threshold value αi set by an operating region and water temperature (S4, S5), when a comparison result is α>αi, it is judged that the state has entered a surge generation region, a valve overlap amount O/L of a suction/exhaust valve is decreased by a decrease amount θt set by the operating region and water temperature, an internal EGR amount is decreased (S6, S7).



LEGAL STATUS

[Date of request for examination] 27.09.2001

[Date of sending the examiner's decision of

rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] By changing the lift property of ** and an exhaust valve relatively, while controlling the amount of EGR(s) from an exhaust air system to an inhalation-of-air system by EGR control valve infixed in an EGR path which is characterized by providing the following, and which connects an exhaust air system and an inhalation-of-air system, the amount of bulb overlap of ** and an exhaust valve is controlled, and it is the EGR control unit of an internal combustion engine which can adjust the amount of internals EGR. A knocking generating area distinction means to distinguish a predetermined operating range which knocking tends to generate based on an engine's operational status A knocking detection means to detect knocking by said said distinguished predetermined operating range An ignition timing amendment means to amend ignition timing according to said detected knocking level It is the amount control means of internals EGR which adjusts the amount of internals EGR in a surge judging means to judge whether close is in a surge generating area based on the amount of amendments of ignition timing according to said knocking level, and the direction which controls the amount of bulb overlap of said ** and exhaust valve, and avoids a surge when judged with close being in a surge generating area.
[Claim 2] An EGR control unit of an internal combustion engine according to claim 1 characterized by detecting surge level, decreasing opening of said EGR control valve when surge level is large, and carrying out reduction amendment of the amount of EGR(s) in operating range other than said predetermined operating range while canceling adjustment of the amount of internals EGR by the amount of bulb overlap of said ** and exhaust valve.
[Claim 3] A judgment of whether close is in said surge generating area is the EGR control unit of an internal combustion engine according to claim 1 or 2 characterized by performing the amount of lag amendments of ignition timing as compared with a threshold set up for every operating range.
[Claim 4] Adjustment of said amount of internals EGR is the EGR control unit of an internal combustion engine of any one publication of claim 1 characterized by decreasing only a decrement set up for every operating range, and performing the amount of bulb overlap of ** and an exhaust valve - claim 3.
[Claim 5] An EGR control unit of an internal combustion engine according to claim 3 or 4 characterized by amending at least one side of a threshold for said surge generating area judging, and a setting decrement of the amount of bulb overlap of ** and an exhaust valve based on an engine's circulating water temperature.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention is EGR (exhaust air reflux) of the internal combustion engine which reduces an NOx discharge, aiming at improvement in fuel consumption. It is related with a control unit.
[0002]
[Description of the Prior Art] While aiming at NOx reduction by flowing back in an inhalation-of-air system in a part of exhaust air conventionally, increasing throttle-valve opening, reducing a pumping loss, and aiming at improvement in fuel consumption is performed. By the way, in the knock control operating range which performs control which performs ignition timing amendment according to knocking level, and maintains knocking level to a correct level, since a surge generating area will become large if an EGR rate becomes high as shown in drawing 6 , ignition timing also has the fault of being restrained by the EGR rate and knock limit. Moreover, in consideration of change of the knock marginal region by environmental conditions, such as circulating water temperature, the variation of ignition timing, the property of an EGR control valve, etc., it is necessary to give additional coverage to a surge generating area and a knock generating area, and to set up an EGR rate, and there is fault that an EGR rate cannot be set up sufficiently highly.
[0003] EGR is decreased, when it detects whether it went into the surge generating area based on the amount of ignition timing amendments according to knocking level in view of this point and goes into a surge generating area (a halt is included.). It is the same as that of the following. There are some which have improved fuel consumption and exhaust air emission, carrying out, avoiding a surge and controlling generating of knocking and a surge (JP,4-325752,A). .
[0004]
[Problem(s) to be Solved by the Invention] However, when a setting EGR rate is beforehand decreased in order not to immediately demonstrate the EGR reduction effect by the EGR gas which remains in an inhalation-of-air system, but for transient performance to fall or to avoid this even if it decreases EGR control valve opening by the above-mentioned conventional surge evasion method, in order to decrease EGR, there is fault that the fuel-consumption effect loses in weight.
[0005] This invention was made paying attention to such a conventional technical problem, and it aims at offering the EGR control unit of the internal combustion engine which enabled it to fully improve fuel consumption and the exhaust air emission engine performance, filling transient performance as a configuration which decreases EGR promptly, when it goes into a surge generating area.
[0006]
[Means for Solving the Problem] For this reason, while invention concerning claim 1 controls the amount of EGR(s) from an exhaust air system to an inhalation-of-air system by EGR control valve infixed in an EGR path which connects an exhaust air system and an inhalation-of-air system to be shown in drawing 1 By changing the lift property of ** and an exhaust valve relatively, control the amount of bulb overlap of ** and an exhaust valve, and it sets to an EGR control unit of an internal

combustion engine which can adjust the amount of internals EGR. A knocking generating area distinction means to distinguish a predetermined operating range which knocking tends to generate based on an engine's operational status, A knocking detection means to detect knocking by said said distinguished predetermined operating range, An ignition timing amendment means to amend ignition timing according to said detected knocking level, A surge judging means to judge whether close is in a surge generating area based on the amount of amendments of ignition timing according to said knocking level, and when it is judged with close being in a surge generating area It is characterized by constituting including the amount control means of internals EGR which adjusts the amount of internals EGR in the direction which controls the amount of bulb overlap of said ** and exhaust valve, and avoids a surge.

[0007] According to invention concerning claim 1, a knocking detection means detects knocking level by predetermined operating range which knocking distinguished by knocking generating area distinction means tends to generate, and ignition timing is amended so that an ignition timing amendment means may maintain this knocking level proper. It judges whether a close surge generating area judging means is in a surge generating area based on the amount of amendments of this ignition timing, and when judged with close being in a surge generating area, the amount adjustment means of internals EGR controls the amount of bulb overlap of ** and an exhaust valve, and the amount of internals EGR is adjusted. Thereby, a surge is promptly avoidable by good adjustment of responsibility by the amount of internals EGR.

[0008] Moreover, by operating range other than said predetermined operating range, invention concerning claim 2 is characterized by detecting surge level, decreasing opening of said EGR control valve, when surge level is large, and carrying out reduction amendment of the amount of EGR(s) while it cancels adjustment of the amount of internals EGR by the amount of bulb overlap of said ** and exhaust valve.

[0009] When it shifts to operating range other than a predetermined operating range which does not perform knock control from a predetermined operating range which performs said knock control according to invention concerning claim 2 While canceling adjustment of the amount of internals EGR by the amount of bulb overlap of said ** and exhaust valve and controlling to a proper value Since surge level is detected, opening of said EGR control valve is decreased when surge level is large, and it was made to carry out reduction amendment of the amount of EGR(s), EGR control which is adapted for operational status and can avoid a surge can be performed. Moreover, a judgment of whether close [invention's concerning claim 3] is in said surge generating area is characterized by performing the amount of lag amendments of ignition timing as compared with a threshold set up for every operating range.

[0010] Although it sets up as a threshold of surge generating of threshold value included in a surge generating area of this amount of lags since according to invention concerning claim 3 it will go into a surge generating area if the amount of lags of ignition timing is enlarged, this value changes with operating range. Then, a surge generating area can be judged to high degree of accuracy by setting up a threshold for this every operating range, and measuring the amount of lag amendments of ignition timing with a this set-up threshold.

[0011] Moreover, as for invention concerning claim 4, only a decrement to which adjustment of said amount of internals EGR was set for every operating range in the amount of bulb overlap of ** and an exhaust valve is characterized by carrying out by making it decrease. According to invention concerning claim 4, it changes with operating range, the decrement of internals EGR of the amount of bulb overlap, i.e., amount, required to avoid a surge. Then, a decrement of the amount of bulb overlap can be set up for this every operating range, and necessity and sufficient EGR control can be carried out to avoiding a surge by decreasing the amount of bulb overlap and adjusting the amount of internals EGR by this set-up decrement.

[0012] Moreover, invention concerning claim 5 is characterized by amending at least one side of a threshold for said surge generating area judging, and a setting decrement of the amount of bulb overlap of ** and an exhaust valve based on an engine's circulating water temperature. According to invention concerning claim 5, since it changes also with an engine's besides said operating range circulating water

temperatures, a threshold for a surge generating area judging and a setting decrement of the amount of bulb overlap of ** and an exhaust valve can be set more as high degree of accuracy by amending these values based on this circulating water temperature.
[0013]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on drawing. Drawing 2 shows the system configuration of 1 operation gestalt of this invention. In drawing 2 , an engine's flueway 1 and inhalation-of-air path 2 are opened for free passage by the EGR path 3, and the valve element 5 of the EGR control valve 4 of a diaphragm type is infixed in the EGR path 3. Negative pressure air is supplied to the negative pressure room 6 of said EGR control valve 4 through a negative pressure-limiting valve 7.
[0014] A solenoid valve 8 is formed in said negative pressure-limiting valve 7, and the negative pressure amount of supply to said EGR control valve 4 is controlled by carrying out drive control of the solenoid valve 8 with a control unit 9. moreover, open closing characteristic (closing motion timing, phase angle) of an inlet valve 10 the adjustable valve timing controlling mechanism (VTC) to control -- it has 11. This VTC11 is the closing motion timing (phase angle) of an inlet valve 10. That what is necessary is just the device made to adjustable For example, the device in which it is used for closing motion timing (phase angle) control of an exhaust valve in JP,7-301106,A (that is, with a cam shaft) The thing of format to which the phase angle between the cam sprockets and **s which transmit rotation of a crankshaft to a cam shaft is changed, or it is indicated by JP,6-2514,A -- as -- hydrostatic pressure and electromagnetism -- the device in which an inlet valve 10 is made to open and close etc. can be used using a solenoid etc., enabling an adjustable setup of closing motion timing. Moreover, device which can carry out adjustable control of the amount of lifts and actuation angle of an inlet valve 10 (VET) You may be a thing and it is closing motion timing (phase angle) at least. What is necessary is just to be able to control to adjustable. furthermore, VTC for inlet-valve 10 (or VET) instead of -- or this -- using together -- VTC for exhaust valves (or VET) What is necessary is to prepare, to control the amount of bulb overlap of ** and an exhaust valve to adjustable, and to just be constituted possible [adjustment of the amount of internals EGR] in short.
[0015] A signal is inputted from the knocking sensor 12 as a knocking detection means, the crank angle sensor 13, a coolant temperature sensor 14, and key switch 15 grade, and said control unit 9 is an engine's operational status (rotational speed, load). It responds and fuel oil consumption, ignition timing, EGR, etc. are controlled. Predetermined operating range which is easy to generate knocking in control of said ignition timing based on engine operational status (heavy load region) When it detects Ignition timing is amended so that knocking level may be held proper based on the signal inputted from said knocking sensor 12. Furthermore, when it detects that a operating range went into the surge generating area based on the amount of amendments of this ignition timing, the amount of internals EGR is decreased by driving said VTC11 and carrying out reduction amendment of the amount of overlap of ** and an exhaust valve. Then, operating range other than said predetermined operating range (low load region) When it shifts, while performing the usual EGR control after canceling reduction amendment of said amount of internals EGR, surge level is detected from rotation rate of change, cylinder internal pressure rate of change, etc., and reduction amendment of the amount of EGR(s) by the EGR control valve according to surge level is performed.
[0016] Control of Above EGR is explained according to the flow chart of drawing 3 . At step 1, the detecting signal from said each sensor is inputted. At step 2, it judges whether it is a heavy load field beyond the predetermined value To, predetermined operating range Tp, for example, basic fuel oil consumption, which is easy to generate knocking, based on said detecting signal.
[0017] When judged with a operating range predetermined at step 2, ignition timing control according to the knocking level which progressed to step 3 and was detected by the knocking sensor 12 is performed. The function of this step 3 constitutes an ignition timing amendment means. When knocking level is under a predetermined value, tooth-lead-angle amendment is specifically performed little by little, when knocking level becomes beyond a predetermined value, control of carrying out lag amendment greatly is repeated, and control which is going to hold knocking level near a knock limit and is going to raise an

output as much as possible is performed.
[0018] Surge generating judging threshold alphai is set up at step 4. Basic threshold alphaio for a surge generating judging corresponding to the operating range i which specifically becomes settled with the basic fuel oil consumption Tp showing the present engine rotational speed N and a present load is searched from the map memorized to ROM (refer to drawing 4). Circulating water temperature detected by this basic threshold alphaio with the coolant temperature sensor 14 (water temperature) Surge generating judging threshold alphai is computed by multiplying by the water temperature correction factor KTW by Tw. That is, as drawing 7 showed, if the amount of lags of ignition timing is enlarged, on the same EGR rate conditions, it will set up as a threshold of surge generating of the threshold value which goes into a surge generating area and goes into the surge generating area of this amount of lags, but since this value changes with operating range and changes also with water temperature Tw, it is set as high degree of accuracy based on these operating range and water temperature Tw.
[0019] At step 5, it judges whether it went into the surge generating area as compared with surge generating judging threshold alphai which computed the amount alpha of lag amendments of the ignition timing at the time of said knock control at step 4. That is, said step 4 and step 5 constitute a surge judging means. When judged with having gone into the surge generating area at step 5, it progresses to step 6 and decrement thetat of amount O/L of bulb overlap of ** and an exhaust valve is set up. Specifically, said basic decrement [similarly corresponding to the present operating range i] thetato is searched from the map memorized to ROM (refer to drawing 5). Decrement thetat is computed by multiplying this basic decrement thetato by said water temperature correction factor KTW. That is, when it goes into a surge generating area, the amount of internals EGR is decreased, a surge is avoided, but since decrement thetat of amount O/L of bulb overlap required to avoid this surge also changes with operating range and changes also with water temperature Tw, it is set as high degree of accuracy based on these operating range and water temperature Tw.
[0020] At step 7, only the decrement thetat which drove said VTC11 and was set up at said step 6 decreases amount O/L of bulb overlap of ** and an exhaust valve. That is, the function of step 6 and step 7 constitutes the amount adjustment means of internals EGR. Thus, when it goes into a surge generating area by knock control, a surge can be promptly avoided by carrying out specified quantity reduction of amount O/L of bulb overlap of ** and an exhaust valve, and decreasing the amount of internals EGR with sufficient responsibility.
[0021] In addition, you may make it provide a part for the response delay running short with reduction amendment of the amount of internals EGR, after it carried out reduction amendment, and the opening of the EGR control valve 4 could also use together the reduction amendment by the amount of external EGR(s) and carries out reduction amendment of this amount of external EGR(s) greatly, when it goes into a surge generating area by knock control. After this condition, if the operating range Tp to which a operating range does not perform knock control of those other than said predetermined operating range, for example, basic fuel oil consumption, shifts to the low load field of under the predetermined value Tpo, it will progress to step 8 from step 2, reduction amendment of amount O/L of bulb overlap of said ** and exhaust valve will be canceled, and it will control in the proper amount according to a operating range.
[0022] Subsequently, it progresses to step 9 and an engine's rotational speed and the opening of the EGR control valve 4 which was classified with the load and which was set as the map for every operating range are searched. At step 10, the surge level beta is detected based on said engine rotation rate of change, cylinder internal pressure rate of change, etc. At step 11, when said detected surge level beta is judged as compared with predetermined value betao to be beyond a predetermined value, only a constant rate or the amount of amendments according to surge level carries out reduction amendment of the opening of the EGR control valve 4 set up at said step 9 in order to progress to step 12 and to avoid a surge.
[0023] It controls by step 13 to become the opening which carried out reduction amendment of the opening or this which searched the opening of the EGR control valve 4 with said step 10 at step 11. EGR control which is adapted for operational status also at the time of a low load, and can avoid a surge

by this can be performed.

[Translation done.]

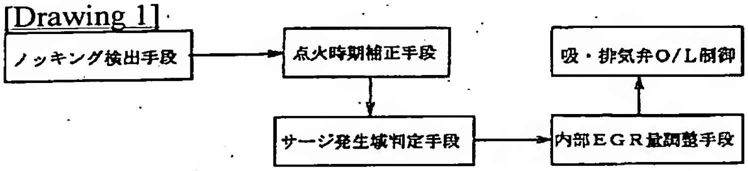
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the configuration and function of this invention.
[Drawing 2] Drawing showing the system configuration of the gestalt of 1 operation of this invention.
[Drawing 3] The flow chart which shows the EGR control routine in the gestalt of operation same as the above.
[Drawing 4] The map of the threshold of the amount of lags used with the gestalt of operation same as the above.
[Drawing 5] The map of the decrement of the bulb overlap used with the gestalt of operation same as the above.
[Drawing 6] Drawing showing the relation between an EGR rate and a surge limit.
[Description of Notations]
1 Flueway
2 Inhalation-of-Air Path
3 EGR Path
4 EGR Control Valve
9 Control Unit
10 Inlet Valve
11 VTC
12 Knocking Sensor
14 Coolant Temperature Sensor

[Translation done.]

DRAWINGS

[Drawing 1]



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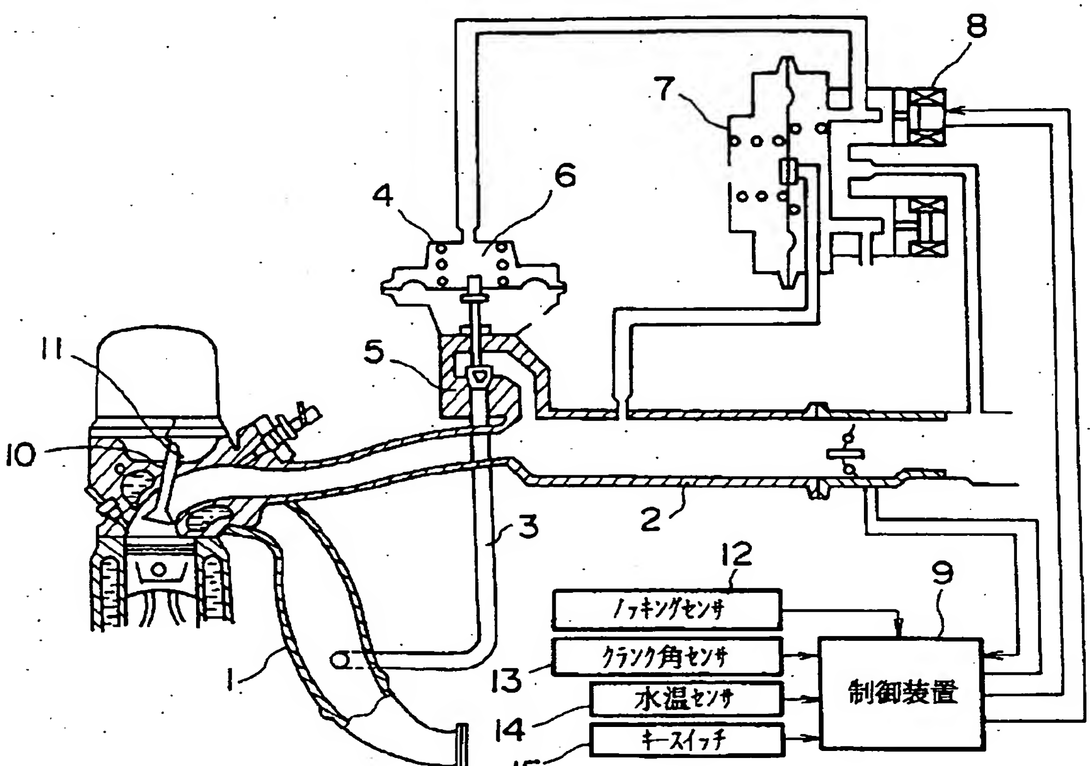

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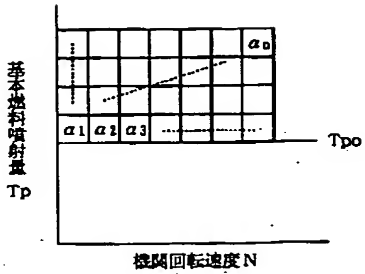

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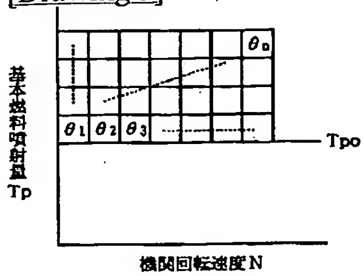

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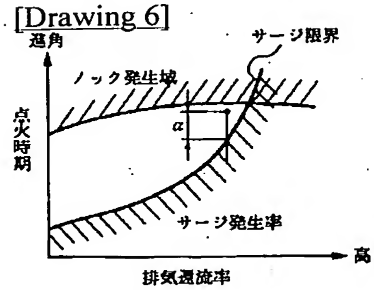

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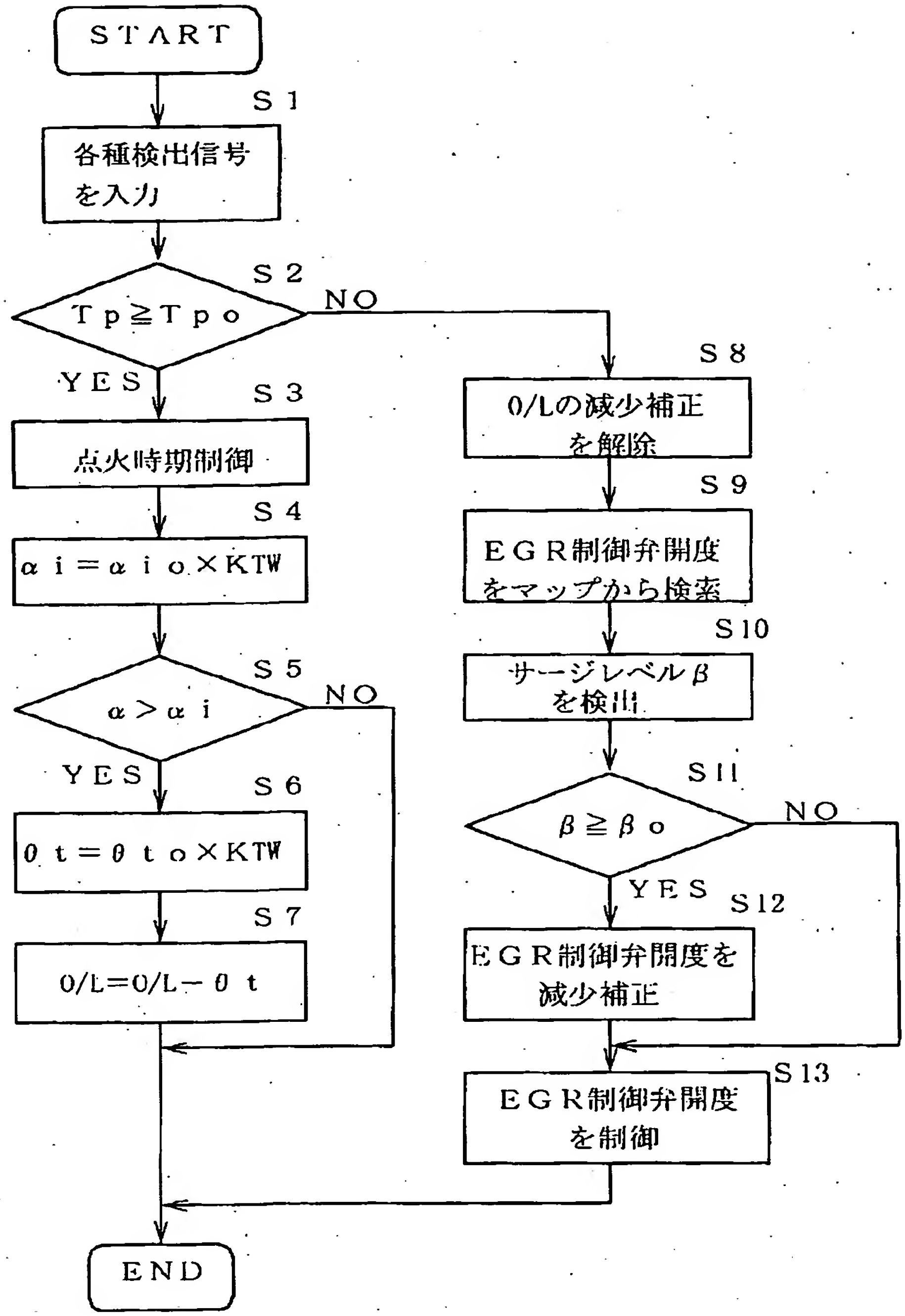

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